VOLUME 79 SEPARATE No. 253

PROCEEDINGS

AMERICAN SOCIETY
OF
CIVIL ENGINEERS

AUGUST, 1953

CRITERIA FOR PLANNING UTILIZATION OF SPACE FOR MAJOR AIR TERMINAL

by George D. Burr

AIR TRANSPORT DIVISION

{Discussion open until December 1, 1953}

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Printed in the United States of America

Headquarters of the Society
33 W. 39th St.
New York 18, N. Y.

PRICE $0.50 PER COPY

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This paper was published at 1745 S. State Street, Ann Arbor, Mich., by the American Society of Civil Engineers. Editorial and General Offices are at 33 West Thirty-ninth Street, New York 18, N. Y.

CRITERIA FOR PLANNING UTILIZATION OF SPACE FOR MAJOR AIR TERMINAL

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OBJECTIVE

Quoting from the "Report of the Subcommittee on Terminal Facilities of the Committee on Airport and Airways Planning of the Air Transport Division" of the American Society of Civil Engineers, published in Proceedings of December 1948, relative to planning airport terminal facilities: "The preparation of construction drawings and specifications and the supervision of construction is less than half of the job."

The objective of this paper is to state how the other half of the job, consisting of developing the basic design criteria for planning the new terminal at San Francisco International Airport, was done by the staff of the San Francisco Public Utilities Commission; and to show the relationship between the traffic flow forecasts made at that time, and the traffic flow developed to date. This paper applies primarily to major terminal airports.

Much useful and well prepared information is available in the publications of the Civil Aeronautics Administration which can be made available to airport planners through the District Airport Engineers and other agencies of the C.A.A. Since such information is readily available, no attempt will be made to repeat it in this paper.

DEVELOPMENT OF CRITERIA

Design criteria for individual airport terminals vary between wide limits depending on the character of the community served, the relationship of the community to adjacent communities, the location on the airways pattern, the general economic conditions, and a number of other complicated factors.

It is desirable to plan the terminal construction for about ten years in the future, and to so plan the facility that the terminal as a whole and the individual components may each be expanded individually as the need arises, to the maximum potential capacity of the airport.

The first step in development of design criteria is a survey to determine the current and expected future traffic to be accommodated by the Airport, and the quantitative use to which the component parts will be put. For an existing Airport, the survey should include a tabulation of past traffic, a current survey of present traffic, and a forecast of future traffic. For an entirely new Airport, the anticipated current traffic potential may be estimated by methods outlined in C.A.A. publication "Airport Planning" and other publications referred to therein.

Chart 1 was prepared in the year 1949. It graphically shows the history since the year 1930 of revenue passenger traffic in-and-out of the Airport, and the number of airline arrivals and departures including extra sections.

The projection that was used as the basis for future traffic estimates is also shown, as well as the actual traffic developed through the year 1952.

Table 1 shows the summary of traffic statistics for the years 1946 to 1952 inclusive for airline arrivals and departures, passengers in-and-out, passengers off and on, mail, express and freight. This table indicates that about 80% of the in-and-out passengers either board or leave the aircraft at San Francisco. It also shows a general rapid growth of air mail, a declining express movement by air, a rapidly increasing air freight business, and an overall steady increase of air cargo where air cargo is defined as the combination of mail express and freight.

A detailed survey was made in the year 1949 to determine, insofar as possible, the quantitative use being made of the various terminal facilities. The results of the survey were tabulated; collated with past history and general regional, national and international trends; and the anticipated traffic for the years 1954 and 1960 were projected. The quantitative uses as counted in the 1949 survey, and projected uses for 1954 and 1960 were tabulated as part of the design criteria for planning the new terminal. This portion of the design criteria are shown in Appendix A.

Appendix A includes only those design criteria involved in the use of specific areas of the terminal. Other equally or more important criteria that were established are:

1. The flow of traffic for passengers, baggage and cargo must be so arranged as to avoid conflict and interference between passengers and baggage or cargo, between baggage and cargo, between incoming and outgoing passengers, and between passengers for different airlines.

2. The entire terminal must be designed for "straight through" operation in order to reduce time and distances to be traveled to a minimum.

   To accomplish this the circulation of outbound passengers must be from surface vehicle to aircraft in a direct and unobstructed path. The flight information, ticket sales, telephones, waiting room, toilets, restaurant, service concessions, concourses and passenger holding area or "gate room" must be provided in that order along the line of travel, but not so as to obstruct the path and not so as to require any appreciable detour to use the facilities.

   The circulation of arriving passengers must be in a direct line, without obstruction, from aircraft to surface vehicle; with baggage reclaiming toilets, waiting room, telephones and service concessions flanking the path in that order but without obstructing or interfering with the direct line of travel.

   At no point should the passengers be required to use stairs or elevators along the primary circulation routes.

   The waiting room for outgoing passengers should be separated from the ticket sales lobby, and that for incoming passengers should be adjacent to but separated from the points of baggage reclaiming and boarding surface transportation.

3. Baggage circulation must be separated from passenger circulation. Outgoing passenger should be relieved of their baggage as soon as practicable, and incoming passengers should reclaim their baggage at a point as near the surface transportation as practicable. Baggage circu-

lation must be direct from ticket sales to aircraft, and from aircraft to baggage reclaiming, and must be rapid.

4. Adequate means must be provided for passengers and baggage to transfer between aircraft, without inconvenience or loss of time.

5. Public health, immigration and customs facilities, for international travel, in that order, must be provided as close to the aircraft parking positions as possible. These facilities must be adjacent to berths that can accommodate the largest type of aircraft that may be expected to engage in international air traffic. A wing span of 200 feet may be expected in the future for some airplanes engaged in this traffic, although 141'-3" wing span is the maximum in current civil use, and 189'-1" is the maximum in current military transport use. These considerations indicate the outer end of a concourse pier as the optimum location for international travel facilities.

6. There should be no unnecessary occupancy in the terminal building and terminal area. To facilitate this principal the following criteria should apply.

   a. Cargo, other than that to be carried on aircraft also engaged in transporting passengers, should be handled at a cargo terminal separate from the passenger terminal.

   b. Facilities for mail and cargo should be in a building separate from the passenger terminal building.

   c. Offices whose functions do not deal with the immediate problems of aircraft, passenger and baggage movement at the terminal, and hotels, garages and similar facilities should not be located in the terminal building, but should be located in the vicinity of the terminal in such a manner so as not to interfere with terminal traffic and operations and so as not to interfere with terminal expansion.

7. Offices and facilities necessary or desirable for terminal building operations, but not relating to the immediate problems of the traveling public should be so located as not to interfere with the basic "straight through" operation of the terminal. Such facilities may include airport administrative offices; Civil Aeronautics Administration and Weather Bureau offices dealing directly with movement aircraft; concessions not needed for immediate service to the traveling public, such as barber shop, deluxe restaurant, etc.; and similar facilities. These occupancies may be located on upper floors or in other areas that will not interfere with the primary circulation systems.

8. The concourses should contain space for all offices and facilities necessary for expediting loading, unloading, servicing, and movement of aircraft to and from the terminal. Such facilities of this type as are not required for use in the immediate vicinity of the terminal should be located in separate airline maintenance and base areas. Such facilities of this type as are necessary at the terminal, must be so located as not to interfere with movement of passengers, baggage, cargo and aircraft.

9. The surface transportation and automobile parking areas must be so arranged as to provide a one-way continuous primary circulation

system, with outgoing passengers' unloading facilities separated from incoming passengers' loading operations.

The distances to automobile parking areas, for passengers and those accompanying them, must be kept to a minimum, and the traffic flow to and from these areas must be so arranged as not to interfere with the main traffic circulation system.

Separate areas should be provided for parking of airport limousines, taxicabs, U-drive vehicles, and employees' automobiles.

Adequate areas, away from the primary traffic circulation system, must be provided for loading and unloading service vehicles.

10. The entire terminal must be made functional but attractive, so as to "sell" air transportation to the public, keeping in mind that the principal sales appeals of air transport are first speed, and second reliability and service.

    Passengers should be kept under cover from the time of leaving their vehicles until arriving at their aircraft. Marquees or other shelter should be provided at the vehicle unloading and loading points. Gate houses should be provided for holding passengers under cover at the aircraft parking positions, for use if loading of the airplane is delayed after the flight is announced.

11. Space for concessions should be provided so as to develop the maximum service to the traveling public and the maximum revenue to the airport operator; but concessions must not be permitted to interfere with the primary circulation systems or with the primary function of the terminal which is to provide a link in an expeditious and convenient transportation system. Revenue from concessions is highly important in order to make the Airport financially practicable.

12. The entire terminal plan and its individual elements must be kept flexible to allow for future changes in methods of operation. This requirement applies to the concourses and related facilities to a marked degree; since aircraft types, sizes, configuration, and methods of loading and servicing are not yet standardized and continuous change in these respects must be expected for some time in the future.

13. The entire terminal, including the various buildings and facilities and each principal occupancy in the terminal buildings, must be capable of separate and individual expansion. No principal element, such as the ticket lobby, cargo handling facilities, baggage facilities or restaurant, should be permitted to be "boxed in" in such a manner that it can not be expanded. If it is necessary to so construct any principal element, such as the area for unloading passengers from surface transportation, so that it may not be readily expanded, such facility should be constructed to the maximum assumed traffic capacity of the Airport as limited by maximum future runway acceptance rate.

    Data for ten years in the future is the maximum projection that can be made with any expectancy of reasonable accuracy. However, flexible provisions must be made for large expansion beyond the projected traffic expectancy for ten years in the future.

    Criterion 13 is perhaps the most important of all.

TRAFFIC TRENDS

Although the above criteria are valid and applicable to design of a major terminal airport such as San Francisco's, and the quantitative survey for the year 1949 is correct, the weakest element in the data used for airport planning is the projection of future traffic, both with respect to volume and types.

The survey was made in the year 1949 and the financing by authorization of the sale of bonds was approved by the electorate in November of that year. The design criteria and future traffic projections were prepared in late 1949 and early 1950. The plans, based on the criteria and traffic forecasts, were prepared in 1950 and early 1951. The terminal has been under construction since the Spring of 1951, and will be occupied in 1954.

It is interesting to note the actual increase in traffic, and the developed trends that have occurred since 1949 and through the year 1952. This information underscores the necessity for so designing a terminal that the allotment of space and use may be changed, and so that the terminal and its component parts may be expanded.

Chart 2 graphically shows the number of revenue passengers in-and-out of the airport on scheduled air transports, and the annual percentage of increase related to the preceding year, for the years 1930 through 1952. The projection of this traffic to the year 1960 that was assumed in 1949, and the current traffic projection are also shown. It will be noted that in 1949 the projection was for 3,000,000 in-and-out passengers by 1960; that in all probability this rate of travel will be reached by the year 1954; and that by 1960 in excess of 5,000,000 passengers will probably be flowing through the airport.

The above increased projection figure may be grossly exceeded if the annual average percentage increase of about 24% per year continues. It is interesting to note that the mean pattern of traffic increase at San Francisco since 1930 closely parallels that for the development of world air transport as shown on chart 3. This has been a history of doubling traffic in a little more than 3 years, and increasing it by eight times in about ten years.

Chart 4 shows a comparison of traffic projections for San Francisco Airport for the years 1950 to 1960, based on various projection factors. The lower line shows San Francisco's projection made in 1949. The next line shows the current Civil Aeronautics Administration's projection, based on a projection factor of 2.3 over 1950 traffic. The next line (heavy line) shows San Francisco's current projection based on history through 1952 of 27.6% increase in 1950, 23.9% increase in 1951, 21.3% increase in 1952; and projected increases of 16.1% in 1953, 13.9% in 1954, and 10% annual increase thereafter until 1960, resulting in a projection factor of 3.52% over 1950 traffic. The next line shows traffic that would develop if an average of 20.205% annual increase over 1950 traffic should continue until 1960. The top line shows traffic that would develop if the trend of world traffic and San Francisco traffic for the last 24 years of an average increase of about 24% annually should continue after 1952 and through 1960.

A very wide range of possible traffic increases is indicated. Most planners have grossly underestimated the future traffic. We in San Francisco may still be greatly underestimating the 1960 traffic, even though our projected figure is 53% above C.A.A.'s projection for average traffic increase throughout the United States for 1960.

Trends in passenger traffic are greatly influenced by a number of important factors, some of the more prominent of which are:

1. The reduction of accident rate to 0.38 fatalities per 100 million passenger miles in 1952.

2. The increased reliability of air transportation created by rapid development of improved aircraft, electronic aids to air navigation, lighting, airports, and traffic control.

3. The increased speed of aircraft, particularly by developing jet transports with speeds in excess of 550 miles per hour.

4. The acceptance and development of high density coach loading of aircraft accompanied by marked reduction of fares so that air transportation is being placed within reach of more customers.

5. The creation of new markets for air travel, the expansion of existing markets, the growth of the communities resulting in corresponding increase of existing travel markets, and increasing industrialization, all tend to increase the use of air transportation.

6. The use of larger aircraft carrying more passengers with a greater load factor, which tends toward lower fares and increased traffic. Load factors for coach loading now average about 75%, and may be expected to reach 80% if economic conditions remain stabilized. This results, in part, in fewer aircraft parking positions or berths being needed to accommodate a given rate of passenger flow, and a smaller number of aircraft per hour using the runway for a given passenger movement volume.

7. The current C.A.A. general criterion of 0.45 berths needed per peak hour transport movements may be lowered. It must be kept in mind that this criterion is of a general nature and is influenced greatly by the type of traffic to be accommodated, as shown in the table below.

Type of Service	Type of Aircraft (or equal)	Time Allowance at Berth
Feeder	Douglas DC-3	15 minutes
Short Haul	Convair 240 or 340; Martin 2-02 or 4-04	25
Intermediate Haul	Douglas DC-4	40
Long Haul	Douglas DC-6; Lockheed Constellation	45
Long Haul	Boeing 377; Lockheed Super Constellation	70

The time allowed at the berth may be materially reduced by installation of improved loading and servicing facilities and techniques.

8. The probable use of helicopters for short hauls, and for feeder service from cities or neighboring communities to major airports, thus reducing the overall travel time.

9. The probable gradual separation of cargo-carrying from generally mixed passenger-and-cargo loading, by placing passengers-plus-baggage and some cargo on one type of aircraft, and all-cargo on another type of aircraft which will load at a terminal separate from the passenger terminal. This trend is being accellerated by the return of about 40 to 45 cents per ton-mile for carrying passengers on air-coach flights, as compared to about 20 cents per ton mile for air freight.

10. Lowering of the differential in cost between air freight and surface transportation shipments, caused by increased volume of air freight, more suitable types of aircraft to transport commodities, improved airport terminals for handling freight, and improved techniques for assembling and distributing freight so as to reduce the overall time needed for air shipments.

11. Possible greatly increased use of air mail, that could be created by raising of ordinary mail rates relative to air mail rates, or determination on the part of the Post Office Department to use primarily air mail between specific suitable terminals.

12. Increased use of private automobiles for conveyance of passengers to and from airports, or the reverse trend of greater use of limousines or helicopters, may change the need for passengers' automobile parking facilities from the present accepted criterion of two parking places for each peak hour passenger on-and-off.

13. The number of movements per hour possible on the runways is increasing due to improved facilities and techniques. The current limitation of a maximum of 30 movements per hour on a runway under instrument flight rules will probably improve in the future to about 40 movements per hour under favorable conditions of airport development and installation of landing aids. There may also be improvement in the limitation of the maximum of 60 movements per hour for a runway under visual flight rules to perhaps 90 movements an hour.

14. The major demand for air cargo movements is between the close of business at night and the opening of business on the following day, resulting in the possibility of the bulk of cargo flights moving at night after the passenger-plane peak movement hours have passed. This trend, coupled with the trend for separating cargo loading from passenger-carrying airplanes, will make greater volume of traffic possible from existing runways, and from existing passenger terminal aprons. By encouraging itinerant and private aircraft to avoid use of the runways during the peak hours for movement of transport aircraft, a greater transport aircraft movement rate may be developed as well as a greater 24-hour use of the airport. When the runway capacity becomes saturated with transport traffic at peak hours, schedules may be rearranged so that the traffic will be more uniformly distributed over the 24-hour day. All of the above tends to make the landing field and terminal capable of accommodating increased annual traffic volume without increasing the peak hour capacity for which they may be designed.

From the above statistics, projections and trends it is apparent that the traffic at San Francisco airport will probably increase at some future date to beyond the 10,000,000 passengers per year in-and-out on scheduled aircraft that has been assumed as the future saturation point for the present landing field configuration. At such time as the increased traffic and revenue potential warrants, an additional pair of runways, including an additional instrument runway, must be constructed in the direction of the prevailing wind. At that time the terminal must also be greatly expanded beyond that previously contemplated as the maximum.

CONCLUSIONS

1. Criteria for design of major terminal airports can differ widely, depending on local conditions.
2. Design criteria should be based on results of a survey of local conditions, correlated with data on regional conditions, national and international trends, data prepared by the Civil Aeronautics Administration, and trends in the development of the air transport industry.
3. Traffic projections should be made for ten years in the future. It is impracticable at the present time to make even remotely accurate forecasts beyond ten years in the future.
4. The terminal and each unit of the terminal should be designed for flexibility in future use.
5. The terminal as a whole, and each important component element, should be capable of expansion independently.
6. Concessions should be planned to develop maximum revenue, but should not be permitted to obstruct the major traffic circulation.
7. Unobstructed direct traffic circulation within the terminal building from surface conveyance to aircraft; outside of the building from the highway to the terminal; and on the apron from runway to loading berth; are fundamental in satisfactory terminal designing.

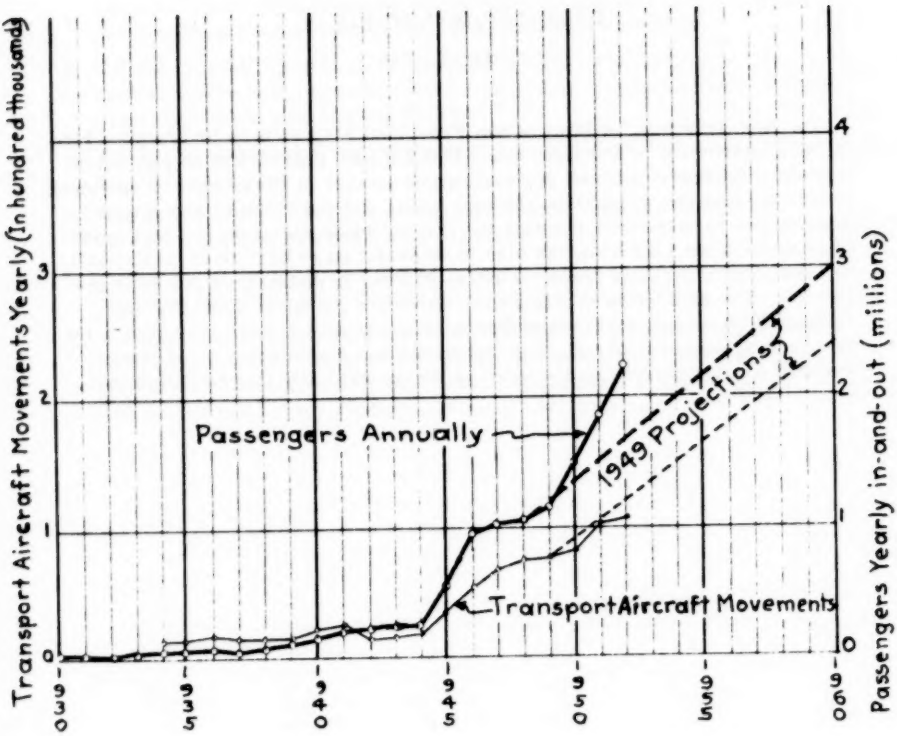
APPENDIX A

NEW TERMINAL BUILDING AT SAN FRANCISCO AIRPORT

BASIC DESIGN CRITERIA

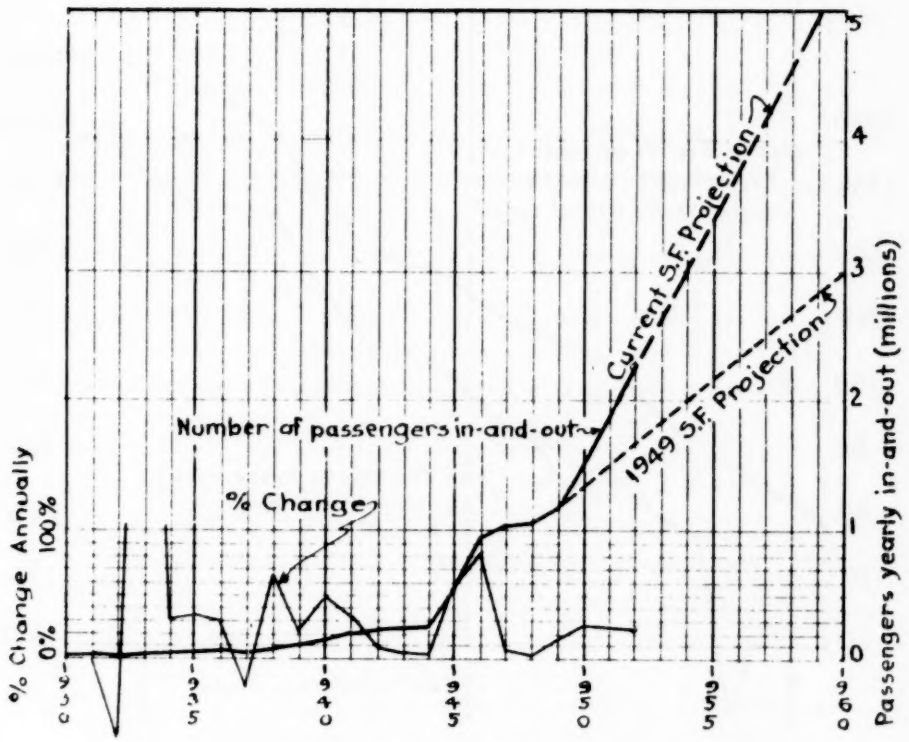
February 17, 1950

The new Terminal Building at San Francisco Airport is to be designed for initial construction to accommodate 3,000,000 paid passengers in-and-out on scheduled transport aircraft per year, which number of passengers is assumed to flow through the Airport by the year 1954, and the building and appurtenances are to be so designed that the critical basic elements can be expanded in accordance with a master plan to be prepared so that the terminal will be capable of ultimately accommodating 10,000,000 passengers per year in-and-out. The data below is intended to correlate the basic 3,000,000 and 10,000,000 passengers-per-year figures with the design requirements for the passengers, concessions, baggage, airplanes and automobiles to be accommodated at peak periods on the basis of the annual basic figures for passengers in-and-out.



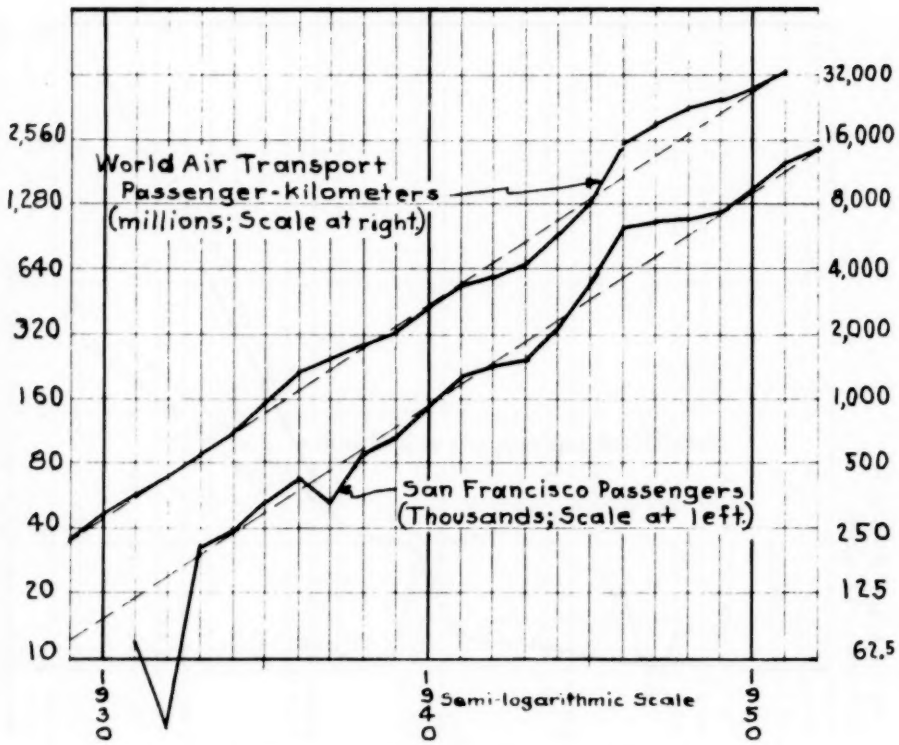
San Francisco Airport
Traffic Projection Made in Year 1949

CHART 1.



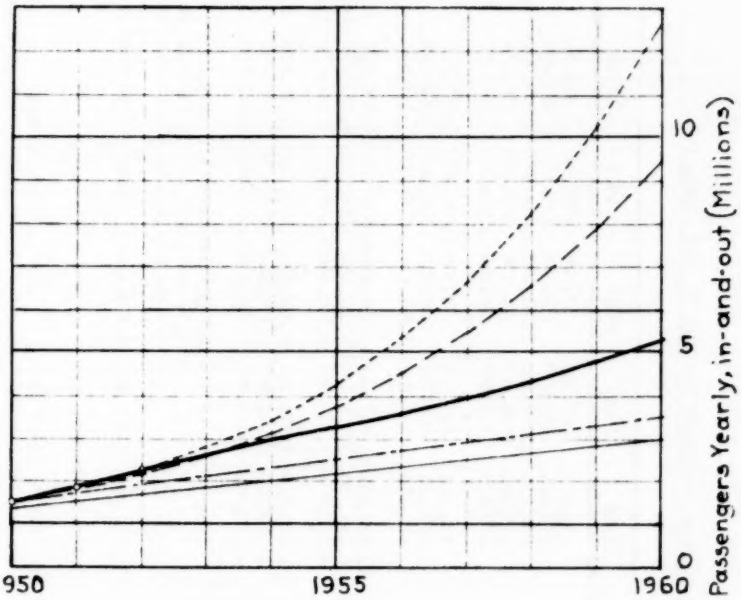
San Francisco Airport
Comparison of Passenger Traffic In-and-Out
With Annual Percentage of Change

CHART 2.



Comparison of Development of
World Air Transport
And Transport Passenger Traffic At
San Francisco Airport

CHART 3.



San Francisco Airport
Comparison of Passenger Traffic Projections.
------Projection for 24% annual increase.
— — " " 20.205% " "
——Projection being used currently.
—·—C.A.A. projection factor of 2.3 over 1950.
——1949. San Francisco Airport projection.

CHART. 4.

TABLE 1

SAN FRANCISCO AIRPORT TRAFFIC STATISTICS FOR 1946 TO 1952, INCLUSIVE

ITEM	1946	1947	1948	1949	1950	1951	1952
Airline arrivals & departures	53,035	67,585	75,929	78,332	82,151	101,613	107,993
Total aircraft movements	119,414	160,078	132,389	129,136	121,038	146,601	160,000+
Passengers, in-and-out	954,710	1,019,384	1,031,212	1,182,570	1,508,760	1,869,863	2,267,674
Passengers, in	477,091	502,826	520,656	592,129	756,134	934,516	1,126,139
Passengers, out	477,619	516,558	510,556	590,441	752,626	935,347	1,141,535
Passengers, off-and-on	834,360	905,308	899,591	1,038,862	1,197,694	1,450,537	1,774,092
Passengers, off	417,484	448,771	456,935	520,403	602,038	726,113	878,476
Passengers, on	416,876	456,537	442,656	518,459	595,656	724,424	895,616
Mail (pounds), off-and-on	12,512,741	11,947,445	13,738,858	14,956,009	17,500,347	30,276,374	29,812,813
Mail, off	6,093,760	5,913,789	7,042,412	7,907,012	9,583,071	18,974,413	17,539,845
Mail, on	6,418,981	6,033,656	6,696,446	7,048,997	7,917,276	11,301,961	12,272,968
Express (pounds), off-and-on	4,610,109	7,575,760	8,868,390	6,935,745	7,778,936	6,705,787	5,843,589
Express, off	2,319,228	2,952,667	4,154,140	2,823,852	3,702,990	3,151,683	2,667,675
Express, on	2,290,881	4,623,093	4,714,250	4,111,893	4,075,956	3,554,104	3,175,914
Freight (pounds) off-and-on			16,286,516	26,016,331	32,419,405	35,356,903	38,465,669
Freight, off			7,546,262	12,003,127	14,774,036	16,455,718	17,345,733
Freight, on			8,740,254	14,013,204	17,645,369	18,901,185	21,119,936
Total Cargo (pounds), off-and-on	17,122,850	19,523,205	38,893,764	47,908,085	57,698,688	72,339,064	74,122,071

Compilation includes statistics reported from the following:

American Airlines
British Commonwealth Pacific Airlines
California Central Airlines
California Hawaiian Airlines
Canadian Pacific, Ltd.
Flying Tiger Line
Pacific Southwest Airlines
Pan American World Airways
Philippine Air Lines
Slick Airways
Southwest Airways Company
Transworld Airlines
United Air Lines
Western Air Lines

NEW TERMINAL BUILDING AT SAN FRANCISCO AIRPORT

DESIGN DATA

February 17, 1950

(Letters in parenthesis, thus (b), refer to notes following the table).

	Data based on annual volume of Revenue Passengers in-and-out		
	1,182,570 Year 1949	3,000,000 Year 1954	10,000,000 Ultimate
PASSENGERS AND PASSENGER ACCOMMODATIONS			
Revenue passengers, in-and-out, per year	1,182,570	3,000,000	10,000,000
Revenue passengers, off-and-on, per year	1,038,862	2,640,000	8,750,000
Average per day for maximum month: (a)			
Revenue passengers, in-and-out	4,230	10,700	36,000
" " off-and-on	3,515	8,900	30,000
Average per day, for the maximum days during the maximum month:			
Revenue passengers, in-and-out	6,350	16,100	53,500
" " off-and-on	5,420	13,750	46,000
Average per hour for the 8 maximum hourly periods during the maximum month:			
Revenue passengers, in-and-out (g)	954	2,420	8,100
" " off-and-on (g)	808	2,050	6,850
Lin. ft. of baggage reclaiming counter needed	50	130	260
Number of pieces of baggage to be handled per hour, during maximum hours, for on-and-off passengers: (b) (g)	1,091	2,770	9,200
Persons in specific areas at one time during average maximum hour: (c)			
In ticket lobby	143	363	1,210
In concourses	138	350	1,170
In westerly arcade (arriving or waiting for transportation)	22	56	190
Sitting in balcony (waiting room) (d)	26	200	660
Ticket windows in use (e)	24	60	120
Number of air lines with ticket windows	11	17	30
Minimum length (in feet) of ticket counter (f)	138	240 to 300	480 to 700
Persons in public rest rooms at one time during max. hr.:			
Men	14	26	120
Women	22	56	185

New Terminal Bldg., S.F. Airport
Sheet 3

- DESIGN CRITERIA -

	Data based on annual volume of Revenue Passengers in and out		
	1,182,570 Year 1949	3,000,000 Year 1954	10,000,000 Ultimate
AIRPLANE BERTHS:			
Number of Airplane Berths, minimum, (g) (h)	17	28	45
Number of air carrier movements per year (one arrival or one departure is one movement)	78,332	143,000	320,000
Air carrier movements per day:			
Average for the year	215	392	877
Average for the maximum month	217	396	886
Average for the maximum day	218	400	895
Air carrier movements for the maximum hours	38	75	180
Air carrier airplane load factors:			
Average for the year	55%	60%	65%
Average for the maximum month	70%	75%	80%
Average for the maximum hours	90%	92%	95%
Passengers per airplane:			
Average for the year	15.1	21.0	31.2
" " " maximum month	19.0	26.2	38.4
" " " " hours	25.0	32.2	45.0
" number of passenger seats per airplane	27.5	35.0	48.0

AIRMAIL, EXPRESS AND FREIGHT			
Pounds per year, off-and-on:			
Air mail	14,956,009	50,000,000)	
Air express	6,935,745	12,500,000)	Ultimate
Air freight	26,016,331	80,000,000)	figures
Pounds per month, off-and-on, maximum month:		)	will be
Air mail	1,955,519	6,540,000)	large
Air express	750,046	1,350,000)	but are
Air freight	2,546,087	7,800,000)	yet
Pounds per day, off-and-on, maximum day:		)	unpredict-
Air mail	80,000	178,000)	able
Air express	30,000	54,000)	
Air freight	100,000	307,000)	

AUTOMOBILE TRAFFIC TO TERMINAL BUILDING			
Revenue passengers arriving and departing hourly during average maximum hours on maximum days.			
(Figures in parentheses show the number of vehicles expected to be loading at one time during peak hours. Half of vehicles will be on each deck)			
Limousine, 38 lin.ft. per loading bus (ea. 35' long)	(5) 307	(13) 778	(30) 2,610
Taxicab, 22 " " " " auto (ea. 18' long)	(10) 130	(26) 328	(85) 1,100
Private vehicle, 22 lin.ft. per loading auto (ea. 18' lg.)	371	944	3,140
Length required in lineal feet	410	1,066	3,010
Public parking area required for revenue passengers for 15 minutes or shorter time; (minimum number of automobiles to be parked at one time)	30	100	350
Min. number of vehicles to be parked at one time (exclusive of those for employees and service vehicles):			
Limousines	8	20	68
Taxicabs	12	30	100
Private automobiles (for longer than 15 minutes)	350	900	3,000
U-Drive	15	40	130
Car Parking for Airport Staff	10	15	30

New Terminal Bldg. S.F. Airport
Sheet 4

- DESIGN CRITERIA -

	Data based on annual volume of Revenue Passengers in and out		
	1,182,570 Year 1949	3,000,000 Year 1954	10,000,000 Ultimate
PATRONAGE OF CONCESSIONS			
Patronage 8:00 AM to 6:00 PM on an average day (on Monday, August 22, 1949):			
News stand	1,013	2,570	8,600
Storage lockers (j)	39	100	330
Dining Room	163	415	1,380
Coffee Shop	1,139	2,900	9,600
Bar	382	970	3,200
Insurance machine	101	256	850
Telephone booths	86	218	730
Telegraph	65	165	550
Shoe Shine	54	137	450
PATRONAGE DURING PEAK HOUR, (MONDAY, August 22, 1949):			
News Stand	150	380	1,300
Storage lockers (j)	8	20	70
Number of storage lockers (j)	30	150	500
Dining Room	75	190	635
Coffee Shop	141	358	1,200
Bar	93	236	785
Insurance machine	23	60	195
Telephone booths	14	35	120
Telegraph	13	33	110
Shoe shine	9	23	76
ASSUMED PATRONAGE DURING PEAK HOURS ON MAXIMUM DAYS: (i)			
News stand	188	475	1,600
Storage lockers (j)	10	25	85
Dining room (Existing seating capacity 125±)	94	240	800
Coffee shop (" " " 73)	176	446	1,500
Bar (" bar stations " 4)	116	294	980
Insurance machine	29	74	250
Telephone booths	18	46	150
Telegraph	16	41	135
Shoe shine	11	28	25

NOTES:

(a) The maximum month for the year 1949 was September

(b) The number of pieces of baggage per passenger is a variable at present, depending on the accommodations purchased and the distance to be traveled.

	Pieces of Baggage Per Passenger
Western Air Lines, average	1.3
United Air Lines, using conventional loading, average	1.4

- DESIGN CRITERIA -

NOTES (Contd.)

	Pieces of Baggage Per Passenger
Flights using strictly coach loading	1.25
Average for normal passenger accommodations	1.35
Flights in excess of 400 miles (estimated)	1.5
Transpacific flights (estimated)	2.0+
Average (assumed) for all passengers	1.35

At present 17.5% of the passengers in and out, and 15.5% of the passengers off and on are coach loaded. This percentage will probably increase.

(c) The figures given for 1949 include both the domestic terminal and the international terminal. When the new terminal building has been constructed, both terminals will be in the new building.

(d) The balcony in the present domestic terminal corresponds to the normally used passenger waiting room. It is very small and inconvenient. It is believed that there would probably be about three times as many persons using the waiting room space if adequate space and facilities were to be provided.

(e) During September 1949 outgoing passengers arrived at the Airport as follows:

MEANS OF TRAVEL	PERCENTAGE
Airlines' Limousines	38%
Taxicabs	16%
Private Automobiles	46%

The 62% of outgoing passengers that arrived by taxicabs and private automobiles were mostly ticketed and had their baggage weighed at the airport terminal building. The airlines believe that most of the remaining 38% who arrive by airlines' limousines will be ticketed and have their baggage weighed at the airport terminal building. In any event the airlines prefer to weigh and check baggage at the airport terminal building for all passengers. Airlines downtown ticket offices are now closed at night and on holidays, which precludes the possibility of routine ticketing at these offices. Downtown offices are used for sales promotion and for selling tickets during the hours that they are open.

(f) The minimum spacing, center to center, of ticket windows is 4 feet. However, it is not practicable to space all ticket windows at this minimum spacing since it does not leave sufficient frontage with office and work space behind the counter for airlines using one to four windows, and does not provide for the additional space needed at the ends and angles of ticket counters. C.A.A. recommends allowing a minimum of 5 to 6 linear feet of counter space per ticket sales window. At present, the 24 ticket sales windows in the domestic

- DESIGN CRITERIA -

NOTES (Contd.)

and international terminals occupy a counter length of about 138 lineal feet, which amounts to about 5.75 lineal feet per window. For the new terminal building the length of counter required is based on 5.5 feet per ticket window.

Some airlines use one scale (furnished by the air line) at each ticket window, while others use one scale for each two windows. Our design is to be based on one scale for each two ticket sales windows.

(g) The figures in these blocks for 1954 and ultimate should be used as the basis of the design for passenger and airplane accommodations in the new terminal building. The figures for ultimate traffic are to be used where the facilities can not be enlarged following initial construction.

(h) Although 17 berths are now existing, 19 are needed at peak hours. As an interim procedure, the number of aircraft parking positions is being increased to 22 to serve until the new terminal can be placed in operation. Some of these are used entirely for air freight loading, which operation can, and probably will, be separated from the passenger, mail, express and freight operations that will be carried on at the new terminal, where passenger and cargo operations are mixed for most aircraft. The assumed number of airplane berths required has been calculated as follows:

B = number of airplane berths needed at the terminal
M = number of air carrier movements per hour.
T = number of airplanes per hour at each berth.

For year 1949 - $B = \frac{M}{2T} = \frac{38}{(2)\ (1)} =$ 19 berths, minimum

For year 1954 - $B = \frac{M}{2T} = \frac{75}{(2)\ (1.33)} =$ 28 berths, minimum

For ultimate - $B = \frac{M}{2T} = \frac{180}{(2)\ (2)} =$ 45 berths, minimum

It will be noted that all of the data in the tables above are calculated on the assumption that peak hour traffic will occur in 1954 and ultimately as it now does. However this will probably not be the case, since when landing field and terminal use becomes saturated during the current six peak hours out of each 24 hours, schedules will undoubtedly be rearranged so that traffic will be more uniformly spread over the 24 hours. The technique of moving airplanes on and off of the runways may be improved so that the aircraft acceptance rate under visual flight rules may become 180 movements per hour instead of 120. The size of aircraft, the density of loading per aircraft by expanded use of air coach travel, and the passenger load factor probably will all increase to some appreciable extent. These five factors, by which the capacity of the airport to accommodate increased traffic without change in runway configuration, makes it reasonable to assume the ultimate capacity of the landing field for dual runways will be at least 10,000,000 passengers per year in-and-out. Therefore, 10,000,000 passengers per year in-and-out has been assumed as the ultimate design figure for the airport terminal.

- DESIGN CRITERIA -

The number of airplanes per hour at each berth is not a static figure. Improved facilities for servicing aircraft at the berth will reduce the time required per aircraft. Airplane types used for feeder service and for short haul service require less time at the berth than those for long haul and international service. Application of these factors is the reason for increasing the factor "T" in the above formula for the year 1954 and for the ultimate field capacity.

(i) Peak hour patronage for 1949 on maximum days is assumed to be 1.25 times that on August 22, 1949, during peak hours. The figures in this block for 1954 and ultimate should be used as the basis for design of the capacity of concessions.

(j) In 1949 there were not sufficient storage lockers to satisfy the demand. Figures for storage lockers for 1954 and ultimate are based on an experience demand for installation of about 5 lockers per 100,000 passengers per year in-and-out.

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